632.63232
A3TR95-03

Montana Department of Agriculture
Agricultural Sciences Division
Technical Services Bureau
Helena, MT 59620

USE OF ACROLEIN AS A BURROW FUMIGANT TO CONTROL BLACK-TAILED PRAIRIE DOGS

by
Monty Sullins
Agricultural Specialist

ABSTRACT

A field study was conducted during September and October 1993, August 1994, and September 1995 to test the efficacy of the aquatic herbicide acrolein (Magnicide H) used as a burrow fumigant to control black-tailed prairie dogs (*Cynomys ludovicianus*). Treatment rates of acrolein ranging from 10 to 100 cc/hole were applied. Efficacy tended to increase with the rate of application but was variable and no treatment exceeded 53% reduction in activity of prairie dogs. Time for application, cost of fumigant, and reopening rates of treated holes data are also presented.

Technical Report 95-03
October 1995

Montana State Library
3 0864 1006 7924 3

INTRODUCTION

Prairie dogs (*Cynomys sp.*), ground squirrels (*Spermophilus sp.*), and pocket gophers (*Thomomys sp.*) cause serious economic damage each year to crops and equipment in Montana. However, the means to control this damage are becoming fewer and more restricted. Compound 1080 (sodium monofluoroacetate) and the above ground use of strychnine are no longer registered for use. Zinc phosphide on grain bait and two types of burrow fumigants (ignitable gas cartridges and aluminum phosphide) are the only rodenticides currently registered for use to control prairie dogs. Poor efficacy with the registered fumigants can result under conditions of porous soils or low soil moisture. Practical use of these fumigants is often limited to short periods of time, usually in the spring or after substantial precipitation.

Kreps and Morris (1992) and O'Connell and Clark (1992) reported that the aquatic herbicide acrolein (Magnicide H, Baker Crop Protection Chemicals) used as a burrow fumigant for controlling California ground squirrels in California was effective, safe, and economical to use. Acrolein has been proposed for use as a fumigant for controlling prairie dogs. Testing is needed to determine if acrolein is an effective rodenticide on prairie dogs.

OBJECTIVES

The objective of this study was to determine the efficacy of acrolein for control of the black-tailed prairie dog when applied at various rates to prairie dog burrow systems.

STUDY AREA

This study was conducted on private rangelands 8 miles south of Billings, Montana, in September and October, 1993. Climatic conditions prior to and during the study were cooler and wetter than average for that period. Precipitation for the period was 3.87 inches and temperatures averaged 64.2 ^{o}F (high) and 40.3 ^{o}F (low) with 2.5 inches, 66.1 ^{o}F, and 42 ^{o}F, respectively, being average. In 1994, the study was continued on millet fields and rangeland located five miles south of Laurel, Montana. Precipitation for August was 0.11 inches (0.9 inches below average) and temperatures averaged 87.8 ^{o}F (high: 2.7 ^{o}F above average) and 59 ^{o}F (low: 1.8 ^{o}F above average). The final portion of the study was conducted 5 miles east of Bridger, Montana, in September 1995. Precipitation was 1.01 inches (1.26 inches average) and temperatures were 70.8 ^{o}F (high) and 46.3 ^{o}F (low) compared to an average of 70.3 ^{o}F and 46.5 ^{o}F, respectively.

METHODS

Nineteen test plots were established and prairie dog activity was monitored by visual counts using binoculars. Three counts were made from the same vantage point on each of three consecutive days prior to treatment. Posttreatment counts were similarly conducted 1, 6, and 21 days after treatment. The highest number of pretreatment and

posttreatment counts provided average pretreatment and posttreatment activity indices (AI). Percent reduction in activity for each plot was calculated using the formula:

$$\text{Percent Reduction} = \frac{\text{Pretreatment AI - Posttreatment AI}}{\text{Pretreatment AI}} \times 100$$

Plots A, B, C, and D were subdivided from two larger plots after pretreatment activity had been monitored. As a result, Plot A was combined with Plot B and Plot C was combined with Plot D to determine percent reduction in activity. These plots served as range finding plots to test various rates of acrolein above and below those recommended to control ground squirrels in California (20 cc/hole).

All prairie dog holes were marked with flags. In 1993, on six plots (A,B,C,D,E,and F), all prairie dog holes were plugged with sod and dirt two days prior to treatment. Only those holes reopened by prairie dog activity were treated with acrolein. On three plots (G,H,and I) holes were not plugged before treatment and acrolein was applied to all holes. In the 1994 and 1995 portions of the study, all holes were treated without prepluging on plots L, M, O, P, Q, and R. To compare the hole reopening rate of treated and untreated plots, holes were plugged and monitored for reopening on control plots K, N, and S.

Immigration of prairie dogs onto study plots was not considered to be significant during the study periods or during posttreatment monitoring.

Acrolein was applied using a calibrated nozzle which was inserted by the applicator into the open burrow entrances. A 50-foot metal mesh reinforced hose connected the nozzle to a 52 gallon supply tank which was mounted on a pick-up drawn trailer. Nitrogen gas was used at 25 psi as a propellant to inject the liquid acrolein. In 1995, a new, more precise nozzle system consisting of an electrical solenoid control was used. All of the treated holes were plugged with sod and dirt immediately after treatment. Four people were used during the application phase of this study; one vehicle driver, one applicator, and two people to locate and plug treated holes.

Cost of materials, application time, and hole reopening rates were also recorded.

RESULTS

Final efficacy evaluations were calculated from visual counts taken 21 days posttreatment (Table 1). Range finding Plots A/B (10/20 cc/hole) and Plots C/D (30/40 cc/hole) resulted in a 50.0% and 79.2% reduction in activity, respectively. Plots E and F, which were treated with 10 and 20 cc/hole, produced 14.3% and 30.3% reduction in activity, respectively. Based on these data, plots G, H, and I were treated with 30, 40, and 50 cc/hole and yielded 23.7%, 51.4%, and 52.8% reduction, respectively. Plots L and M treated with 30 and 60 cc/hole resulted in 40.6% and 50% reduction in activity,

respectively. Plots O and P each received 60 cc/hole that resulted in 50% and 29.4% reduction in activity. Plots Q and R produced 27.3% and 47.8% reduction in activity after being treated with 100 cc/hole.

Percent of burrows reopened at 1, 6 and 21 days posttreatment are listed in Table 2.

The size of study plots, number of burrow treated, manhours required for treatment and cost of acrolein application are listed in Table 3.

No significant changes occurred in pretreatment and posttreatment prairie dog activity counts on control plots J, K, N, and S.

DISCUSSION

The percent reductions in prairie dog activity obtained in this study tended to be proportional to the amount of acrolein applied although there was considerable variability. However, efficacy even at the higher rates was considerably less than the 90 percent or better reduction in activity often obtained by presently registered burrow fumigants and the results of acrolein applications reported for ground squirrel control in California.

Reasons for these lower efficacy levels are difficult to assess. Prairie dogs may differ significantly from ground squirrels in susceptibility to the toxic effects of acrolein. Burrow size and construction may also be factors that effect dispersal and concentration of acrolein. How acrolein gas disperses and the rate at which it disperses throughout burrow systems are not known. Moisture, composition, temperature of the soil and air temperature and humidity in the burrow system may be factors that effect the rate of volatilization of liquid acrolein into a gas. The 1993 portion of this study was conducted in the fall after an unusually cool, wet summer. However, weather conditions were hot and dry in 1994 and near normal in 1995. There was no significant difference in efficacy among the 3 time periods.

In terms of efficacy in this study, no advantage was found by preplugging prairie dog holes and applying acrolein only to those holes reopened by prairie dogs. This procedure is labor intensive but does greatly reduce the amount and cost of acrolein needed for application.

The number of holes reopened tended to decline with increased application rates. It was found in this study that the results of acrolein treatments should not be evaluated until a week or more after application. Significant hole reopening and above ground activities by prairie dogs generally occurred immediately after plugging holes on the untreated control plots. On treated plots, little prairie dog activity was observed within the first few days posttreatment. Posttreatment activity was noted within a week after treatment and maximum activity seemed to plateau 2 to 3 weeks posttreatment. Numerous new burrow openings were observed as prairie dogs resumed digging activities. Treatment sites may

have been avoided because of residual acrolein.

RECOMMENDATIONS

Registration of acrolein as a burrow fumigant to control black-tailed prairie dogs is not recommended at this time. Other currently registered pesticides result in more consistent and efficacious control provided that they are used at the appropriate time and good appliation conditions. The higher rates of acrolein application used in this study would be cost prohibitive for most operational prairie dog control. Increased application rates, even if efficacious, would not be economically practical.

The apparent good efficacy of acrolein on ground squirrels in California indicates conditions and methods may be discovered that result in similar efficacy on prairie dogs. Accomplishing this is likely to require developing additional information concerning the volatilization properties of acrolein under different environmental conditions (temperature, humidity, soil types, etc.) and the characteristics of gaseous acrolein (density, dispersion rate, toxicity to pest species, etc.) and prairie dog behavior including burrow size and depth, interconnectivity of burrow systems and acrolein avoidance.

Field application of acrolein as a burrow fumigant indicated potential injury to applicators from dermal, eye and inhalation exposure might occur. Applicator training, which should include safety practices and precautions such as storage and transport procedures and use of personal protective equipment during application of acrolein, needs to be developed.

ACKNOWLEDGEMENTS

I wish to thank Dan Sullivan, Montana Department of Agriculture (MDA), for technical and application assistance and review of the manuscript. Rande Roth, MDA, assisted in study operations. Dale Carpenter of Baker Crop Protection Chemical provided the acrolein, application equipment, and made the acrolein applications. Todd Burnhardt provided and drove the vehicle carrying the acrolein and nitrogen tanks. I sincerely thank Dick Cooper, Ben Decker, Mrs. Frank Pelican, and Joe Reicher for allowing the use of their properties to conduct the study.

LITERATURE CITED

Kreps, L.B. and G. Morris. 1992. A study to determine the effectiveness of acrolein as a burrow fumigant for Belding ground squirrel control. California Dept. of Food and Agriculture Report. Redding, California 96002.

O'Connell, R.A. and J. Clark. 1992. A study of acrolein as an experimental ground squirrel burrow fumigant. Fifteenth Vertebrate Pest Conference Proceedings. p. 326.

00172\vert\tr9503.dds

Table 1. Reduction in activity of black-tailed prairie dogs using visual counts after treatment with acrolein 1, 6 and 21 days posttreatment.

Plot/Treatment	Percent Reduction in Activity Posttreatment Day 1	Day 6	Day 21
A/10 cc	-96.4	-57.1	-50.0
B/20 cc	*	*	*
C/30 cc	-95.8	-80.4	-79.2
D/40 cc	*	*	*
E/10 cc	-85.7	-25.0	-14.3
F/20 cc	-100.0	-45.5	-30.3
J/Control	-3.3	+6.6	+ 1.0
G/30 cc	-92.1	-34.2	-23.7
H/40 cc	-100.0	-83.8	-51.4
I/50 cc	-100.0	-75.0	-52.8
K/Control	-100.0	-28.0	- 0.7
L/30 cc	-80.8	-[illegible]	-40.6
M/60 cc	-36.1	-30.5	-50.0
N/Control	-37.5	-34.3	- 9.4
O/60 cc	-92.9	-71.4	-50.0
P/60 cc	-76.5	-79.4	-29.4
Q/100 cc	-84.8	-69.7	-27.3
R/100 cc	-93.8	-56.3	-47.8
S/Control	-25.0	-20.8	-4.1

* - Percent reduction in activity were combined for Plots A and B and Plots C and D.

Table 2. Percent of holes reopened after treatment with acrolein at 1, 6 and 21 days posttreatment.

Plot/Treatment	Percent Holes Reopened Posttreatment Day 1	Day 6	Day 21
A/10 cc	8.4	38.6	62.7
B/20 cc	2.3	31.8	65.9
C/30 cc	1.7	18.3	47.5
D/40 cc	3.4	6.5	24.3
E/10 cc	0.6	33.3	74.8
F/20 cc	2.2	26.5	67.3
J/Control	*	*	*
G/30 cc	4.0	7.9	14.5
H/40 cc	3.4	7.0	11.1
I/50 cc	0.6	6.1	12.7
K/Control	1.5	40.5	57.5
L/30 cc	2.4	14.7	62.3
M/60 cc	14.3	57.8	61.7
N/Control	30.1	71.6	76.4
O/60 cc	6.2	21.6	49.7
P/60 cc	6.1	34.1	66.7
Q/100 cc	2.2	13.3	59.8
R/100 cc	3.9	14.3	52.6
S/Control	22.9	74.4	78.2

* - Burrow closures on the control plot were not conducted in this portion of the study.

Table 3. Size of study plots, number of burrows treated, hours of treatment labor and cost of acrolein application.

Plot/ Treatment	Size (Acres)	Holes Treated	Applc. Time mnhrs/100 burrows	Acrolein cost/hole
A/10 cc	1.7	83	2.3	$.07
B/20 cc	1.5	88	*	$.14
C/30 cc	2.0	120	2.2	$.21
D/40 cc	1.7	107	*	$.28
E/10 cc	8.7	258	2.0	$.07
F/20 cc	7.1	223	2.0	$.14
J/Control	9.9	-	-	-
G/30 cc	6.9	509	2.0	$.21
H/40 cc	8.7	496	3.2	$.28
I/50 cc	5.5	512	3.5	$.35
K/Control	8.3	-	-	-
L/30 cc	37.5	538	4.4	$.21
M/60 cc	28.1	230	6.0	$.14
N/Control	9.9	-	-	-
O/60 cc	4.7	338	2.3	$.42
P/60 cc	3.7	490	2.0	$.42
Q/100 cc	6.2	458	1.3	$.70
R/100 cc	4.5	230	2.8	$.70
S/Control	5.7	-	-	-

* - Hours of treatment labor were combined for Plots A and B and Plots C and D.